Injury Rate Problem at Maxmore Mine

Instructor Copy

Behavioral Research Aspects of Safety
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Contents

Exercise Summary

Read this section first. It describes the exercise format, content, and the skills that are emphasized. This exercise description, the problem booklet table of contents, the exercise instructions, and the sequences of activities listed in Table 1 provide an overview of the type of tasks required by this exercise and the time necessary to complete these activities.

Type: Paper and pencil with short written answers followed by group discussion

Audience: Mine health and safety trainers and those who plan and approve such training programs

Length: Eleven activities with a few questions for each activity
(Completion of the exercise requires a minimum of 8 hours of classroom work.)

Skills:
- Assessing accident data within a broad perspective of possible causes and evaluator needs, roles, and perspectives
- Gathering data and additional information that can help identify and define a problem
- Identifying probable underlying causes for the nominal problem
- Conceptualizing intervention strategies and actions that are likely to address and correct the problem of high injury and accident rates
- Judging the effectiveness of other's attempts to define problems and implement training programs to correct these
- Recognizing the limitations of training as a means for correcting problems and demonstrating the ability to conceptualize corrective strategies other than training
- Formulating training and evaluation plans in the context of a problem solving perspective given case study materials about mining accidents

Location: Supervisory or training office where training plans and programs are designed and evaluated

Problem: Injury rates at Maxmore Mine (an underground coal mine) have increased to three times the national average in the last quarter. As an education, training, and safety specialist who develops and approves training plans, you are asked to examine a summary of the accidents for Maxmore Mine. The task is to suggest corrective actions to lower the injury rate. Next, three case studies are presented. Each case study describes attempts by one director of health and safety to reduce injuries at Maxmore Mine. You are asked to judge the strengths and limitations of each approach, to decide if the program would be effective, and whether or not it should be approved. Following discussion of these initial case materials, you are asked to apply the exercise principles to another case study situation involving injuries to contract workers at surface mines. Finally, a homework assignment asks you to apply the exercise principles to a real-world problem of your choice where improved training and performance evaluation may be one means to reduce accident and injury rates.

Instructions for Administration of Exercise

This exercise has eleven parts or activities with a few questions in each part. Each activity asks the trainees to make judgments and decisions about developing and evaluating programs to reduce injury rates at a mine. A suggested time limit is given for answering the questions in each section or activity. Try to stick to this time limit. Otherwise the exercise may not be finished.

When the time limit for each activity is up, ask the trainees to move to the next activity. Materials needed for each activity are included in the problem booklet. The activities occur in order from A to K. Divider pages (blank except for the word "stop" printed in large type) separate each section of the exercise. Each divider page indicates that the work for the current section should be completed before turning the page and continuing on in the problem booklet. Make sure trainees do the exercise activities in order - turning to and using the materials for each activity as the exercise progresses. Trainees may NOT jump ahead, but may look back at any time. Materials in the earlier activities provide information needed to complete later sections. Later activities present feedback and information about earlier questions. You, as the instructor, will guide trainees' progress through the exercise and provide additional information and opportunities for discussion as the exercise progresses.

Work is best done in groups of two or three persons to complete the exercise. One person in each group should write down the answers on the answer sheet. When trainees have finished the exercise, each should individually complete the quiz that is part of the answer sheet. A copy of their completed answer sheet may help trainees with the homework assignment for the exercise.

Before beginning the exercise, look at the table on the next page. It provides an overview of the approximate time required to complete each activity in the exercise.

Table 1: Overview of Exercise Activities and Time Allocation

Activity	Task	Time[2]
Introduction	Overview of exercise purpose and content	10
A	Review problem scenario and accident summaries and make recommendations for reduction of NFDL injuries at Maxmore Mine	30
B	Analyze case study 1	20
C	Analyze case study 2	20
D	Analyze case study 3	20
E	Compare and evaluate strengths and weaknesses of each case study	30
F	Basics of evaluation and problem solving: Judging how problem identification and definition influence proposed solutions and their evaluation	30
G	Judge the worth of evaluation data for providing information about the effectiveness of programs	30
H	Review and use guidelines for evaluating proposed training plans and programs	30
I	Recognize four common methods for evaluating the effectiveness of training	40
J	Apply problem solving and evaluation principles to reduce injury rates to contract workers	150
K	Exercise conclusion and homework assignment	30
	Total time needed to complete these initial activities	8 hours
	Four to six week intercession for completion of the homework assignment. Time needed to complete homework	24 hours
	Students present and discuss their homework assignments. Time needed for presentations & discussions	4 to 6 hours

[2] Unless otherwise noted, times are in minutes and are approximate. Breaks will increase the total time for the initial activities to approximately 8 classroom contact hours. Time for group discussion is included in the estimates for each activity. The time needed for the presentation of the trainees' homework assignments depends upon the number of presentations and their detail.

Appendix A: Basics of Evaluation and Problem Solving

Basics of Evaluation and Problem Solving

Evaluation Defined - Gathering information to make judgments and decisions about the worth of objects, programs, products, or events against specific criteria. The criteria may be explicit or tacit. The information upon which the decision making is based may be adequate or inadequate.

Evaluation is ongoing and pervasive in all human activity.

Evaluation occurs within a problem solving framework, and always within a personal and social context that biases:

a) how problems are identified and defined,

b) the criteria used to evaluate the worth of the solutions, and

c) the information collected.

Problem solving has been studied for many years. It is generally agreed to consist of the following steps:[1,2]

I = Identify the problem. Sense, find, or recognize the problem in relation to the personal and social needs (biases) that are foremost in the evaluator's awareness.

D = Define and represent the problem. Decide what class of problems this problem falls into. Decide how to think about and approach this problem in terms of other problems that have been solved successfully and unsuccessfully in the past. Recall relevant knowledge and experience that help further define the problem and how it can be approached. The experience of other persons is always important in defining problems.

E = Explore possible strategies. Match possible strategies and actions that have the best chance of solving the problem that has been identified and defined. Discard strategies which are irrelevant or impossible. Select strategies that are possible given available time, resources, and conditions.

A = Act on the strategies. Gather resources needed to implement the strategies. Overcome obstacles and barriers. Carry out the actions that most efficiently and fully implement the best strategies to achieve the intended goal. The cooperation and support of other persons is almost always needed to implement actions. Failure to win this support often prevents effective action.

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[1] Bransford, J. D., & Stein, B. S. (1984). The IDEAL Problem Solver: A Guide for Im roving Think* . Leaming. and Creativity. New York: Freeman.

[2] Mayer, R. E. (1983). Thinking. Problem Solving. Cognition. New York: Freeman.

L = <u>Look back</u> and EVALUATE the effects of the problem solving activity. Was the solution to the problem satisfying, effective, and worthwhile? Did the strategies and actions achieve the desired goals? Did the problem solver get what he or she wanted and expected? Why or why not? What should be done differently next time to better achieve the desired goals? Why? Was the problem identified the primary problem or was it a background problem?[3] Were the problem definition, goals, strategies, and actions suitable to the problem as it is now understood?

This **IDEAL** process is repeated again and again for problems encountered. As the process is repeated the person tends to redefine and better understand the problem, and to develop strategies and actions that are more effective and satisfying.

<u>Problem Solutions are Temporary and Partial</u>

Solutions to real life problems tend to be partial and temporary. The same problems tend to reappear and have to be dealt with again and again. Once strategies at Maxmore Mine achieve a low accident rate, the problem is only temporarily solved. The same or similar problems will occur at this mine in the future. Each reoccurrence will require new problem solving and evaluation efforts.

<u>Most Errors in Problem Solving Occur in the Identifying and Defining Stages</u>

Many studies reveal that most errors in problem solving involve failure to sense or recognize the primary problem. Usually a background problem is wrongly identified as the main problem. Examples occur in interpersonal relationships, mathematics, aviation, and mining accidents[4,5,6,7] as well as in the design of products and programs. When a

[3] A background problem is often not the nominal problem that needs attention, but some other problem that is salient in the mind of the evaluator(s). This is illustrated by the behavior of the flight deck crew of a passenger jet. The jet was in a holding pattern preparing to land. The nominal problem was to attend to the altimeter and other instruments, messages from the control tower, and the holding pattern. However, the pilot, copilot, and flight engineer all concentrated on replacing a light bulb in the instrument panel. This warning light had come on indicating a problem with the landing gear locking mechanism. The flight crew determined that the problem was with the bulb, not the landing gear. They had removed the bulb from the instrument panel, checked it, and experienced difficult re-inserting the bulb in the panel. The background problem of re-inserting the bulb in the instrument panel focused the attention of all three officers on this task. During this time the autopilot failed and went unnoticed by the crew. Over a period of a few minutes the plane spiraled into the ground and crashed. The flight crew appeared to be unaware of the nominal problem of low altitude and the impending crash even though low altitude alarms sounded on the flight deck, and an airport control tower operator queried the crew about their deviation from the holding pattern and their low altitude. Background problems are common in all areas of life. They often compete for attention with more pressing problems that need attention. It is often not clear which is the nominal problem and which is the background problem until after the fact.

[4] Cole, H. P., Mallett, L. G., Haley, J. V., Berger, P. K., Lacefield, W. E., Wasielewski, R. D., Lineberry, G. T., & Wala, A. J. (1988). <u>Research and Evaluation Methods for Measuring Nonroutine Mine Health and Safety_ Skills. Volumes 1 & 2</u>, (Final Report Contract No. HO348040). Pittsburgh, PA: U. S. Bureau of Mines, Coal Mine Health and Safety Program.

[5] Cole, H. P., Wasielewski, R. D., Lineberry, G. T., Wala, A. J., Mallett, L. G., Haley, J. V., Lacefield, W. E., & Berger, P. K. (1988). Miner and trainer responses to simulated mine emergency problems. In <u>Mine Safety Education and Training Seminar</u>, (pp. 56-77). (Bureau of Mines Information Circular No. 9134). Washington, DC: Government Printing Office (128.27:9185).

problem is wrongly identified and defined, the subsequent actions and strategies, and the evaluation of their effectiveness are also compromised. One cannot evaluate programs, products, or activities without thinking about how well the attempted solution addressed the primary problem.

Evaluation of Programs and Products is Best Conceived as Formative

Evaluating training programs, products, or other activities of persons working to solve a problem is best thought of as an ongoing activity. What is learned in one stage can contribute to developing better programs and evaluations in the future.[8,9]

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[6] Passaro, P. D., Cole, H. P., & Wala, A. (1989). Miners' misconceptions of circuits as a factor influencing underground mining accidents. In Proceedings of the Fourth U. S. Mine Ventilation Symposium, (pp. 147-155). Littleton, CO: American Society of Mining Engineers.

[7] Wala, A. M., & Cole, H. P. (1987). Simulations that teach and test critical skills in mine ventilation. In J. M. Mutmansky (Ed.) Symposium, (pp. 132-141). Littleton, CO: American Society of Mining Engineers.

[8] Cole, H. P., Moss, J., Gohs, F. X., Lacefield, W. E., Barfield, B. J., & Blythe, D. K. (1984). Measuring Learning in Continuing Education for Engineers and Scientists. Phoenix, AZ: Oryx Press.

[9] Cole, H. P. (1971). Process Education. Englewood Cliffs, NJ: Educational Technology Publications.

Appendix B: Problem Booklet

Duplicate this copy of the problem booklet for use in your classes. **Booklets should be printed on only one side of the paper.** Each person in your class should have a problem booklet while they are working the exercise. The problem booklets are reusable.

Injury Rate Problem at Maxmore Mine

Problem Booklet

Instructions

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When the time limit for each activity is up, the instructor will ask you to move to the next activity. Materials needed for each activity are included in the problem booklet. The activities occur in order from A to K. Divider pages (blank except for the word "stop" printed in large type) separate each section of the exercise. Each divider page indicates that you should complete the work for the current section before turning the page and continuing on in the problem booklet. Do the exercise activities in order turning to and using the materials for each activity as the exercise progresses. Don't jump ahead, but you may look back at any time. Materials in the earlier activities provide information needed to complete later sections. Later activities present feedback and information about earlier questions. The instructor will guide your progress through the exercise and provide additional information and opportunities for discussion as the exercise progresses.

Problem at Maxmore Mine Case Materials

Background

You are an education, training, and safety specialist responsible for planning and approving miner training programs.

Maxmore Mine is an underground coal mine. The director of health and safety has worked at this mine for 10 years and in this job for 4 years.

Seam height is 74 inches. The coal bed is tabular and level at a depth of 460 feet below the surface.

There are 320 underground employees at this mine.

Annual production is 2.5 million tons.

Coal is mined with electrically powered continuous miners. Haulage is by diesel shuttle cars and conveyor belt.

There is little turnover among employees. The average miner has been at Maxmore for 12 years.

The mine has a fire clay bottom and it has been wetter than normal this last quarter.

The maintenance shop is underground. It is large and well equipped.

All miners have been trained in basic lifting techniques for about 20 minutes every other year using available MSHA training films and materials.

The annual refresher training cycle at this mine is scheduled to begin in about six weeks.

Problem

Non-fatal days lost work (NFDL) injuries at this mine are up over the last quarter. The incident rate (0.17) is about 3 times the industry average and four times the company average for the last year.

Activity A, Reducing Injury Rates at Maxmore, Question 1 (30 minutes)

1. Review the attached summary of accidents for this mine for the last quarter. What would you do to reduce this increase in NFDL injuries? (Describe what you would do, why you would do it, and how you would go about it.)

Maxmore Mine Accident Summaries for Last Quarter

1. While eating lunch, miner was peeling apple. Pocket knife slipped and cut his hand. First aid was administered. Three days later the miner got blood poisoning. (5 days lost)

2. Oil can fell from a pallet and struck left ankle of section utility man who was loading cutter bits and roof bolts into a scoop. Hospital x-ray showed his ankle was not broken. Diagnosed as a sprain. (10 days lost).

3. Mechanic helper and a mechanic lifted a hydraulic pump from a scoop bucket on section 003. Helper stated he hurt his back and complained of pain the rest of the shift. Next morning helper called and said he couldn't work because his back was out. Subsequently received medical treatment for a strained back. (7 days lost)

4. Two miners were loading roof bolts and rock dust at the supply point for section 007. Victim tripped on a pile of cable and fell on bolts hurting chest and ribs. He was taken out of the mine on a stretcher. X-rays at hospital showed two broken ribs. (15 days lost)

5. Mechanic servicing a shuttle car was prying the roadway drag up so he could loosen the chain that holds it. He slipped and pulled a muscle in his left groin. He went off shift, was examined by a nurse, and sent home. (2 days lost)

6. A miner slipped and fell as he dismounted the mantrip when he entered his work section at the beginning of the shift. Struck his chin on the mantrip. Cut required 6 stitches at hospital emergency room. (1 day lost)

7. A maintenance man working on a shuttle car injured left hand while he was removing roadway drag to perform routine maintenance on a shuttle car. Hand swelled up. Medical exam showed hand bruised. (2 days lost)

8. Miner tripped and fell on timbers while loading rock dust from a supply point on section 005. Medical exam showed he sprained knee. (10 days lost)

9. Roof bolter operator struck in the eye by a small piece of slate while drilling roof. Miner stated his eye hurt. Completed shift but called in next day and said his eye was swelled shut. Received medical treatment. (4 days lost)

10. Section mechanic broke thumb while he and helper were changing a wheel on a shuttle car. The mechanic fell and the wheel rolled from a scoop bucket onto his hand. (3 days lost, plus 6 weeks on light duty in the tool crib)

11. Mechanic strained his back while attempting to lift a heavy object in an improper manner while performing maintenance on a shuttle car. (3 days lost)

12. During routine maintenance a roadway drag fell from a jack and struck a pry bar. The bar struck a mechanic helper, cutting his cheek and lips and breaking a tooth. Injury required 12 stitches and dental work. (4 days lost)

13. A section mechanic was pulling cutter bits and other parts out of a shuttle car so that he could work on the miner. He threw his back out and had to be taken to the hospital. (3 days lost)

14. While loading timbers in a scoop, a utility man positioned himself in an unsafe position between the timbers and a stack of brattice blocks nearby. Blocks fell from the stack, striking the miner on the head and back. He complained of pain in his head, neck and upper back. Medical exam at hospital found bruises. (1 day lost)

15. An electrician on section 009 was injured when he attempted to lift a battery lid on a scoop. Complained of back pain and went off shift early. Was treated for a dislocated disk at local clinic. (40 days lost)

Stop !

Case Study Analyses

The next four activities involve reviewing and evaluating three case studies. Each case study is a summary of how a mine director of health and safety actually responded to an increase in NFDL injury rates like those experienced at Maxmore Mine.

Read the first case study. Then answer the two questions for that case study. Then read the second case study and answer the next two questions. Then read the third case study and answer the next two questions. The fourth activity asks you to compare the three case studies and comment on the strengths and weaknesses of each health and safety director's attempt to reduce NFDL injuries among miners.

Activity B, Case Study 1 Analysis, Questions 2 & 3 (20 minutes)

Read the following case study describing the approach of one director of health and safety as he attempted to lower the NFDL injuries at Maxmore Mine.

In your role as an education, training, and safety specialist who plans and approves training plans:

2. What suggestions would you offer Truman Wells concerning his approach to the problem? Why?

3. Would you approve his proposed training? Why or why not?

Case Study 1: Truman Wells' Approach

Truman Wells is the director of health, safety, and training at Maxmore Mine. He reviews the mine accident data. He notes that many of the accidents are related to sprains and strains from lifting and pulling. He finds that most of the injuries are to mechanics and maintenance personnel. He guesses that the wet and slippery bottom conditions may be a factor in the increased injury rate.

Truman himself has had a bad back for a number of years. He has recently attended a workshop concerned with prevention of musculoskeletal injuries through proper lifting techniques. The program was developed by medical specialists who treat back and other musculoskeletal injuries. The program teaches workers the importance of, and the techniques that underlie correct lifting procedures. The developers claim a two fold reduction in back and musculoskeletal injuries among workers at a warehouse where the program was implemented. Truman decides to obtain and implement this program for all miners at this operation. He will include the program in annual refresher training. It will require about 2 hours. Annual refresher training classes will be scheduled for the maintenance crews and mechanics first. Later classes will present the program to all other workers.

Stop !

Activity C, Case Study 2 Analysis, Questions 4 & 5 (20 minutes)

Read the following case study. It describes the approach of another director of health and safety as he attempted to lower the NFDL injuries at Maxmore Mine.

In your role as an education, training, and safety specialist who plans and approves training plans:

4. What suggestions would you offer to Cody Buchannon concerning his approach to the problem? Why?

5. Would you approve his proposed training? Why or why not?

Case Study 2: Cody Buchannon's Approach

Cody Buchannon is the director of health, safety, and training at Maxmore Mine. He reviews the accident data for the last quarter. He decides he needs more information.

He then interviews each miner who had a lost time injury to learn more about the details of each accident. He also visits the sections and areas of the mine where the injuries occurred, to observe work conditions and procedures. He finds that the injuries fall into three categories. Five of the injuries were to mechanics and maintenance workers who were in the process of adding or removing roadway drag rails that were installed on all shuttle cars earlier that year. The drags weigh about 800 lbs. and are attached to the front end of the shuttle cars to smooth out the mine bottom. Routine maintenance on the shuttle cars require the drag bars to be removed and then reinstalled. Four other accidents were to maintenance personnel and mechanics working on mine sections. They were injured while lifting heavy electric motors, hydraulic pumps, and similar parts from scoops or shuttle cars in the process of changing out these components on equipment on the mine sections. Four additional accidents were sprains, strains, and fractures received by miners who were loading supplies into scoops from underground supply points. These miners said that the supplies were tangled and poorly stacked which made them difficult to lift and move. Cody's inspections confirm that housekeeping is poor at the section supply points.

Cody meets with the supply crews and the mine foreman. He shows them his findings and insists on better housekeeping and ask what he needs to do to help them do a better job. They request cooperation from the face crews in maintaining well organized supply points. Cody next talks with the mechanics and maintenance crews. He shows them his findings and asks them to help him think of easier ways to remove and reinstall the roadway drag rails on the shuttle cars, and to lift and move heavy components that are being changed out on equipment that is not in the shop. The crews come up with two simple solutions. An 8 inch ramp and platform made from railroad ties and crushed rock filling is constructed. When a diesel shuttle car needs the drag removed, it is trammed so the drag slides up on the ramp. Then the chains are unhooked and the car backs away. When maintenance is complete the car trams to the ramp and the drag bar is re-attached. No jacking or lifting is required. The second solution is the installation of a "monorail" (section of railroad track) on the mine roof in a crosscut near each section supply point. A chainfall is rigged to this monorail. It is used to lift heavy motors, pumps and other components into and out of scoops, shuttle cars, and other equipment near the face.

Cody decides he will share the result of his findings, and the solutions to these problems in annual refresher classes. He will take about 20 minutes to encourage miners and supervisors to continue to think about ways to make work easier, prevent injuries, and increase production.

Stop !

Activity D, Case Study 3 Analysis, Questions 6 & 7 (20 minutes)

The following case study describes the approach of a third director of health and safety as he attempted to lower the NFDL injuries at Maxmore Mine.

In your role as an education, training, and safety specialist who plans and approves training plans:

6. What suggestions would you offer to Harold Klinghorn concerning his approach to the problem? Why?

7. Would you approve his proposed training? Why or why not?

Case Study C: Harold Klinghorn's Approach

Harold Klinghorn is the director of health, safety, and training at Maxmore Mine. He reviews the accident data. He notes that many of the accidents are related to slips and falls and to sprains and strains from lifting and pulling. He finds that most of the injuries are to mechanics and maintenance personnel.

Harold has recently read an article about accident repeaters and accident prone miners. He is worried about poor supervision by section foreman and malingering by miners who claim they have injuries. He feels that this recent increase in injuries would not have occurred if mine supervisors were more conscientious in supervising their crews. He also suspects that a number of the NFDL injuries were not serious, did not require time off from work, and were faked by some of the miners. When he checks, he finds four of the fifteen miners who received lost time injuries worked the remainder of the shift after receiving the "injury". Not until the next morning did they call in and claim they could not work. One of these miners with a back injury had done this twice before within the last year.

Harold reviews the company accident records for the three previous years. A total of 51 NFDL accidents have occurred in the last three years, plus the 15 additional accidents in this quarter. Eighteen of the 51 earlier accidents involved the same 5 miners, each of whom had three or more accidents in the three year period. One of these persons has also had a fourth accident in the last quarter.

Harold decides to implement an accident monitoring program that is designed to identify malingering and accident proneness among miners. He meets with the general mine foreman and all mine section foremen to share his suspicions and findings with them. He demands tighter supervision and better documentation of any injuries that occur on the mine property. He develops procedures that will identify miners who appear to be accident repeaters or malingerers. Once identified, these individuals are to be monitored. Documentation will be gathered on each person. When sufficient evidence is gathered, each problem miner will receive individual counseling and instruction. If a problem miner does not improve (have fewer injuries) he or she will be reassigned or terminated.

Harold will schedule time in annual refresher training to report what he has found. He will not identify individual miners, but will share his evidence for accident proneness and malingering. He will point out that most of the miners at this operation are honest and hard working, and that they and the company are being made to look bad by a few malingerers and accident prone miners. Then he will describe the new accident monitoring system, and how it will identify and deal with problem individuals.

Stop !

Strengths and Weaknesses of the Case Studies

You have reviewed the NFDL accident summaries for Maxmore mine and thought about what you would do to lower the injury rate. You have also reviewed three case studies. Each case study was an attempt by a mine director of health and safety to reduce NFDL injuries like those at Maxmore Mine. Now answer and discuss the following questions.

Activity E, Merits, Questions 8 & 9 (30 minutes)

8. What are the strengths and weaknesses of each training director's approach? Why?

9. Which approach do you feel is the most typical? Why?

After you have answered these questions, discuss your ideas with other class members and the instructor.

Stop !

Summary of Case Study Strengths and Weakness

A brief summary of the strengths and weaknesses of each training director's approach follows. Can you suggest additions or changes?

Case Study 1: Truman Wells

Strengths

1. Identified workers most at risk.
2. Scheduled training for these workers first.
3. Program is basically a positive, educative approach.

Weaknesses

1. Failed to review injury data and take preventive action as accidents (near injuries) and injuries occurred during the quarter.
2. Insufficient information gathered concerning likely causes of the accidents.
3. Problem prematurely identified or wrongly identified and poorly defined.
4. No assessment of miners' on-the-job performance of proper lifting techniques prior to implementing more training.
5. Unrealistic reliance on "more training" as a solution to the problem.
6. Poor use of limited annual refresher training time. One quarter of the available time was devoted to a topic that has been repeatedly taught, and that may do little to solve the problem. Class time may be needed to refresh other critical skills.

Case Study 2: Cody Buchannon

Strengths

1. Gathered additional information from interviews and observation.
2. Identified specific tasks and jobs related to the observed injury data.
3. Problem clearly identified and defined based on multiple data sources.
4. Intervention goals and strategies clearly formulated and tied directly to specific work tasks.

5. Involved work crews and supervisors in developing procedures to prevent injuries, make work easier, and increase productivity.

6. Solution to problem conceptualized broadly in terms of work procedures, ergonomic improvements for problem tasks, and training to orient work crews and supervisors toward prevention of future problems.

7. Efficient use of limited annual refresher class time.

8. Program is a positive, preventive education approach that integrates strategies for improving the quality of the work place, safety and health, and production.

Weaknesses

1. Failure to review injury data and take preventive action as accidents (near injuries) and injuries occurred during the quarter.

2. More time and effort is required by the director to clearly identify the problem and time is needed to involve supervisors and work crews in generating solutions.[1]

3. Miners may need additional task training in the use of the shuttle car drag ramps and the monorail chain hoists on the sections.[2]

Case Study 3: Harold Klinghorn

Strengths

1. May identify, discourage, and terminate a few workers who falsely claim or exaggerate injuries.

2. May identify persons (or jobs) that are at greatest risk of injury and provide an opportunity for intervention to reduce these risks.

Weaknesses

1. Failure to review injury data and take preventive action as accidents (near injuries) and injuries occurred during the quarter.

2. Insufficient information gathered concerning likely causes of the accidents.

3. Problem prematurely identified or wrongly identified and poorly defined.

[1] Although the initial time and effort is greater, the long term savings in terms of active employee involvement in the program, reduction of injuries, and increased production may also be greater. Thus, this willingness to carefully define the problem and involve the miners in overcoming the problem can be viewed as a strength.

[2] The observations made in the previous footnote apply to this situation as well.

4. Punitive, judgmental mind-set seeks to establish a policy that will offend all workers to correct the possible misbehavior of a few.

5. Accident repeater programs tend to blame the victim rather than promote safer work environments and practices.

6. Basic assumptions about accident proneness and accident repeaters being responsible for the increased injury rate, and making other workers and the company look bad, are incorrect as determined by many studies.[3]

7. Program is a punitive, divisive, and negative approach that does little to educate workers who are not targeted as "accident repeaters" and does little to prevent problems in the future.

8. Persons identified as "accident repeaters" may simply be persons at the extremes in the chance distribution of persons injured or not injured.

[3] See the appendix at the end of the problem booklet for more information on accident proneness.

Stop !

How Problem Identification and Definition Affects the Solution

Listen as the instructor reviews the attached handout "Basics of Evaluation and Problem Solving." Then discuss the following questions.

Activity F, Problem Identification and Definition, Questions 10 & 11 (30 minutes)

10. Describe how the identification and definition of the problem influenced the choice of subsequent strategies and actions by each training director -in the case studies.

11. As an education, training, and safety specialist who approves training programs you need to be concerned that the program that is proposed will effectively address the problem to be solved. To evaluate the adequacy of a proposed program you need information about the problem, about the training proposed to overcome the problem, and about the people involved. Think about this. Then make a list of some key questions you should ask while gathering information about a proposed training program.

After you have answered these questions, share your ideas with other members of the class and the instructor. Then your instructor will provide you with some additional information.

Basics of Evaluation and Problem Solving

Evaluation Defined - Gathering information to make judgments and decisions about the worth of objects, programs, products, or events against specific criteria. The criteria may be explicit or tacit. The information upon which the decision making is based may be adequate or inadequate.

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Problem solving has been studied for many years. It is generally agreed to consist of the following steps:

I = Identify the problem. Sense, find, or recognize the problem in relation to the personal and social needs (biases) that are foremost in the evaluator's awareness.

D = Define and represent the problem. Decide what class of problems this problem falls into. Decide how to think about and approach this problem in terms of other problems that have been solved successfully and unsuccessfully in the past. Recall relevant knowledge and experience that help further define the problem and how it can be approached. The experience of other persons is always important in defining problems.

E = Explore possible strategies. Match possible strategies and actions that have the best chance of solving the problem that has been identified and defined. Discard strategies which are irrelevant or impossible. Select strategies that are possible given available time, resources, and conditions.

A = Act on the strategies. Gather resources needed to implement the strategies. Overcome obstacles and barriers. Carry out the actions that most efficiently and fully implement the best strategies to achieve the intended goal. The cooperation and support of other persons is almost always needed to implement actions. Failure to win this support often prevents effective action.

L = Look back and EVALUATE the effects of the problem solving activity. Was the solution to the problem satisfying, effective, and worthwhile? Did the strategies and actions achieve the desired goals? Did the problem solver get what he or she wanted and expected? Why or why not? What should be done differently next time to better achieve the desired goals? Why? Was the problem identified the primary

problem or was it a background problem? Were the problem definition, goals, strategies, and actions suitable to the problem as it is now understood?

This **IDEAL** process is repeated again and again for problems encountered. As the process is repeated the person tends to redefine and better understand the problem, and to develop strategies and actions that are more effective and satisfying.

Problem Solutions are Temporary and Partial

Solutions to real life problems tend to be partial and temporary. The same problems tend to reappear and have to be dealt with again and again. Once strategies at Maxmore Mine achieve a low accident rate, the problem is only temporarily solved. The same or similar problems will occur at this mine in the future. Each reoccurrence will require new problem solving and evaluation efforts.

Most Errors in Problem Solving Occur in the Identifying and Defining Stages

Many studies reveal that most errors in problem solving involve failure to sense or recognize the primary problem. Usually a background problem is wrongly identified as the main problem. Examples occur in interpersonal relationships, mathematics, aviation, and mining accidents as well as in the design of products and programs. When a problem is wrongly identified and defined, the subsequent actions and strategies, and the evaluation of their effectiveness are also compromised. One cannot evaluate programs, products, or activities without thinking about how well the attempted solution addressed the primary problem.

Evaluation of Programs and Products is Best Conceived as Formative

Evaluating training programs, products, or other activities of persons working to solve a problem is best thought of as an ongoing activity. What is learned in one stage can contribute to developing better programs and evaluations in the future.

Stop !

The IDEAL Process and the Maxmore Mine Case Studies

Examine this summary of the problem solving steps carried out by each of the three training directors. Each summary describes how the training director identified and defined the problem. Then the strategies and actions are described. The last section tells how the training director evaluated the results of his program to reduce NFDL injuries at Maxmore mine.

Case Study 1: Truman Wells

Identification	Assume increased accident rate caused by improper lifting techniques.
Definition	Miners don't know how to lift properly or don't follow correct lifting procedures. Maintenance workers are at greatest risk. Past training not effective.
Explore Strategies	More training needed. Better training needed. Train in annual refresher classes. Train at risk group first.
Act on Strategies	Locate better program (training materials). Plan annual refresher class schedule to allow time for new program.
Look Back (Evaluate)	Prepare a questionnaire that asks miners 1) Did you like the program? 2) Did you learn valuable information and skills? 3) Will you use what you learned when you work? 4) Is what you learned useful at home and other places off the mine property? 5) Should this program be continued in the future? 6) Was the instructor effective? 7) Were the training materials and activities effective? Tally the results of the questionnaire and report the results to the mine management. Truman will also use the results of the evaluation to improve the program before it is presented again.

Case Study 2: Cody Buchannon

Identification	Accident rate has increased. Need more information to determine why.
Definition	Gather more information. Visit work sections. Interview injured miners. Talk with work crews and supervisors. Share information and the miners and their supervisors to help identify causes. Following this activity the problem is defined as poor

housekeeping at section supply points and improper job design for lifting and moving heavy components on the sections.

Explore Strategies — Involve miners and their supervisors in generating ideas for problem solutions. Improve housekeeping at supply points. Make ergonomic changes for lifting heavy components on mine sections and for removing and installing roadway drags. Use small amount of annual refresher training to report what has been learned and to encourage ongoing prevention of other problems in the future.

Act on Strategies — Meet with supervisors and work crews and the mine foreman. Insist on and work to improve housekeeping. Install monorails and roadway drag bar ramps. Plan a short but effective summary of what was learned to present to annual refresher classes.

Look Back (Evaluate) — Over the next year monitor accidents and near accidents as they occur including interviews with the persons involved. Continue to visit work sections and observe work procedures. Summarize the number of NFDL injuries and their causes at the end of each quarter. Encourage supervisors and work crews to identify other potential sources of injury or production loss. Ask them to think of ways to avoid or overcome these problems. Keep records of the numbers of problems identified and the strategies and procedures developed to overcome these. Compile these data into a series of graphs and brief written reports so that the results can be shared with mine management, MSHA and state inspectors, and miners in future refresher training classes.

Case Study 3: Harold Klinghorn

Identification — Assume increased accident rate caused by a few problem workers and careless supervision.

Definition — Review of company records for three years prior identifies 5 accident repeaters. Accident reports for the last quarter show that at least four miners who claimed they were injured worked the rest of the shift following the alleged injury and did not report to work on a subsequent shift. The increasing accident rate is caused by lax supervision and a few problem miners.

Explore Strategies — Review the accident repeater identification program that was reported in a trade journal article. Increase first line supervisor awareness of possible malingering and tighten supervision. Develop procedures to identify and correct accident proneness. Present findings to company management to gain their support.

Develop standard forms and records for keeping track of problem miners.

Act on Strategies — Prepare a brief summary of the findings using tables and graphs. Justify the program as protecting the company and honest workers from the dishonesty or carelessness of a few problem workers. Present the program as one positive way to assist and train accident prone workers to help them and their families, and as a way to identify and discourage malingerers. Use about 20 or 30 minutes of annual refresher training time to explain the program and announce its mine wide implementation.

Look Back (Evaluate) — Over the next two years keep detailed records that identify accident repeaters. Compile more information on these persons based on supervisors' observations. Determine if the persons involved are accident prone or malingerers. Arrange special counseling and training sessions for these persons. If these persons continue to have accidents following their counseling, compile data that can be used for their reassignment or termination.

Activity G, Judging the Worth of Evaluation Plans, Questions 12 & 13 (30 minutes)

You have considered how each training director's problem identification and definition influenced his proposed training plan, strategies, and solutions.

Now think about the evaluation part of the strategy for each case study. Remember that evaluation is defined as the gathering of information to make judgments about the worth of programs, products, and activities, and to make decisions about how to do things differently.

12. Review the "Look Back (Evaluate)" section for each training director. These are summarized in the previous section. Which training director's evaluation plan can provide data useful for judging the worth of the program for decreasing NFDL injuries at this mine? Explain.

13. Suppose that after Harold Klinghorn's accident repeater program is implemented, the NFDL injury incident rate at the mine drops from 0.17 to 0.04. Harold says this is proof that the program reduces injuries. Is he correct, or is there an alternative explanation? Explain.

After you have answered these questions, discuss them with other members of your class and the instructor. Then the instructor will summarize some guidelines useful for evaluating proposed training programs.

Stop !

Guidelines for Evaluating Training Plans and Programs

To properly evaluate the worth of a training program, it is important to gather information about each step of the problem solving process that generated the program. These or similar questions can help gather the necessary information.

1. Who identified the problem? What biases and concerns does this person or group of persons have? How have these personal and social needs influenced how the problem is identified and defined?

2. In what broader context does the problem occur? What else is going on? Are there other more important problems that need attention?

3. Is the problem identified by the trainer (company):

    a) concerned with a meaningful and significant issue worthy of further training and instruction?

    b) related to improving health and safety (as opposed to explaining company retirement benefits, summarizing the extent of company involvement in community service activity, or designed mainly to be entertaining for the miners, etc.)?

4. Are the instructional strategies and actions proposed based on accurate information, as well as the knowledge and experience of others?

5. Are the proposed training strategies functional, practical, and achievable? Can the proposed program be implemented given available time, resources, and limitations?

6. Are the proposed training strategies likely to improve miners' knowledge, skills, or performance in the problem area?

7. Can the problem identified be effectively addressed through more training (new miner, refresher, OJT, task training etc.), or is some other non-training approach likely to be more effective? (e.g. ergonomic changes, enforcement, changes in policy and work procedures, etc.)

8. How will the trainer know if the training has made a difference? What attempts have been made by the company or trainer to evaluate the effectiveness of the program? What does the proposed evaluation tell you about the goals and intentions of the proposed training?

Activity H, Using the Guidelines, Questions 14, 15, 16, & 17 (30 minutes)

14. Think about the guidelines in the previous section. Now think about the three case studies. Could seeking answers to these types of questions help you evaluate training plans or programs like these? Explain.

15. Could raising these types of questions help mine trainers improve their instruction? Explain.

16. Education, training, and safety specialists are busy people with many demands upon their time. The guidelines require gathering much information. Are the guidelines of value in the real world, or are they too idealistic and impractical? Explain.

17. List two or three things that you have learned from this exercise that may be useful in your work as you evaluate training plans and programs. Explain how each point listed may help you.

Stop !

Four Methods for Assessing Training Effectiveness

Training is a major activity in nearly all companies and organizations. Trainers are usually asked to be accountable. This usually includes keeping records of how many persons were trained for what purposes, in what skills, for how many hours, over what period of weeks or months, and at what cost per trainee. In addition to this information, organization managers frequently want to know if the training has been effective, e.g. whether the effort was worth the cost.

The information collected is used to make decisions about whether to continue, discontinue, or change training programs, about which persons to train in what skills, what types of courses and programs to offer for which groups, and about alternative methods for teaching, testing, and maintaining employees' proficiency in their jobs. Recent research supported by the National Science Foundation and the American Society for Engineering Education resulted in a book that explores these issues and provides detailed methods for dealing with them.[4]

One part of the overall evaluation process concerns how trainers seek to assess what effects their instructional programs have had on the course participants. The methods that trainers use to make this determination have been classified into four types. [5,6] A description of each type and information about its frequency of use and credibility is provided in the table on the next page.

[4] Cole, H. P. et. al. (1984).
[5] Kusy, M. E. (1988). The effects of types of training on support of training among corporate managers. Performance Improvement Quarterly, 1(2), 23-30.
[6] Kilpatrick, D. (1975). Evaluating Training Programs. Madison, WI: American Society for Training and Development.

Table 2: Training Assessment Strategies

Strategy Name and Description	Frequency of Use (%)[7]	Credibility with Managers[8]
Reaction Evaluation--Survey forms and questionnaires that assess how the trainee felt about the training, its value, content, methods, and quality.	73	Moderate
Learning Evaluation--Quizzes and tests that assess how much information the person has learned and can recall from all or some of the content of the training.	82	High
Performance (Behavior) Evaluation--Direct observation and assessment on specific criteria of the trainee's performance of the particular skills that have been taught in OJT or classroom training.	19	High
Results (Outcome) Evaluation—Tabulation of objective criteria that should be affected by increased skill acquired by employees during training, e.g. increased production, lower injury rate, less damaged or lost equipment and materials, etc.	12	Very High

[7] From Smeltzer, L. R. (1979). Do you really evaluate, or just talk about it? Training, 17 (8), 6-8. [As cited in Kusy, 1988, 1, (2), pp. 9, 25.]
[8] Kusy, (1988).

Activity I, Recognizing the Four Methods, Tasks 18, 19 & 20 (40 minutes)

This activity has four parts. Each part helps illustrate key points made in this exercise, as well as illustrates the four common methods used for training evaluation. At this point, do the tasks described in items 18 through 21 below.

18. Recall the instructor's review of the four common methods trainers use to evaluate training results.

19. Complete the quiz that is attached as the last page of your answer sheet.

20. Score your quiz as the instructor discusses each question.

When you finish the instructor will have you score your quiz so this information can be summarized and discussed.

Stop !

Scoring Key for the Quiz

Question	Answer	Discussion
1	False	He used a reaction evaluation form. He could have easily given a knowledge test or a performance test.
2	True	All that was needed was to have miners demonstrate the proper lifting techniques, or miners could have been observed lifting while on the job.
3	True	It asks for your impressions about the worth of this exercise on several criteria.
4	True	He sought data about two types of results: 1) Changes in injury rates and types, and 2) Degree to which miners and supervisors continued to watch for and correct potential problems.
5	False	Just because the evaluation is based on objective results, one cannot conclude that the problem has been properly identified and defined, nor that appropriate strategies have been developed and implemented. Harold Klinghorn's plan is a good example of this point.
6	False	The quiz is a knowledge or learning evaluation. To obtain a measure of performance change, we would have to observe if you evaluate training programs differently than you did prior to this workshop.
7	False	Reaction evaluations provide valuable information about how the trainees judged the worth of a program and the effectiveness with which it was presented.
8	True	He used a results or outcome approach. But his data probably are invalid for evaluating the actual rate of injury reduction.
9	True	A reaction evaluation approach might have informed him of the great degree of discontent with such an approach. Failure to be sensitive to the wants and needs of workers can promote strife, law suits, stress, and a more dangerous work place as the quality of communication and cooperation among workers and management decreases.
10	False	Your answers to the questions on the exercise are a learning evaluation or a performance evaluation. To do a results evaluation, we would have to look at changes in the quality of training for those companies or agencies for which you plan

and approve training. We could also look at how many trainers in your region seek out your help because they value your assistance.

11 You may not use much formal evaluation. Most instructors do not. However, every instructor, and those for whom he or she works, do evaluate the effectiveness of training on their own criteria. They use whatever information they have available to make decisions about the value of training programs, the assignment of instructors and resources, the termination or addition of classes, etc. Perhaps the most frequent method of evaluation is asking a few of the participants if the course was good, if the instructor was effective, and if the person learned from and enjoyed the experience.

12 You probably have seen reaction evaluations or learning evaluations most often, or perhaps no formal evaluation which may be most common. For some tasks like fire fighting, first aid, and donning SCSRs, performance evaluation is easy and appropriate. Yet is not uncommon to see instructors attempting to evaluate the effectiveness of their instruction of these skills by using short reaction evaluation or short learning evaluation measures that cannot possibly test proficiency in the skills that have been taught.

Stop !

Reducing Injury Rates to Contract Workers

You have learned how to apply problem solving and evaluation strategies to plan programs and activities that can help to reduce rates of mine accidents and injuries. Now you will be asked to apply these principles to another set of case materials. These materials describe high injury rates to contract workers at surface mines.

Activity J, Reducing Contract Worker Injuries, Questions 21, 22, & 23 (150 minutes including time to present your answers to the class).

At this time review the "Contract Worker Injury Case Material" that appears on the next page. Then prepare a brief one or two page report that answers each of the following questions.

21. What are the main issues and the primary problems involved in these injuries to contract workers on mine property?

22. What are some strategies that the companies can use to prevent these types of accidents in the future? (Think about training, enforcement (inspections), and engineering approaches.)

23. What are some specific ways state, federal, and company inspectors might evaluate the effectiveness of the training received by contract workers, and also evaluate the effectiveness of company practices concerning how these persons work on mine property?

Tips

After you prepare written answers to these three questions, be prepared to present and discuss a verbal summary of your recommendations with your classmates and the instructor.
As you prepare your recommendations:

a. Make use of your knowledge of current state and MSHA policy and the law as these relate to this issue.

b. Use what you have learned from the Maxmore Mine exercise to help you identify and define the problem, explore and act on strategies, and to think of ways to evaluate the effectiveness of training and supervision of contract workers.[9]

c. Use your own prior knowledge and experience about this problem area, as well as information from the accident summaries that are attached.

d. Remember that you are not now evaluating training or supervision policies. Rather you are to identify and define the problem and develop strategies to better evaluate the adequacy of training and supervision of contract workers who work on mine property. Your goal is to comply with the law and to also develop practical plans and strategies that can prevent future accidents involving contract workers.

[9] Refer to the "IDEAL" problem solving process on pp. 28 - 34, the "Guidelines for Evaluating Training Plans and Programs," pp. 37 - 39, and "Training Assessment Strategies," p. 41.

Contract Worker Injury Case Materials

Background

You are a newly appointed education, training, and safety officer for a large organization.

Your office is responsible for 12 surface coal mines and 8 underground coal mines.

In the last 8 months there have been five serious accidents involving contract workers who were on mine property at the mines in your region. (See the attached accident summaries.)

Four of the accidents have occurred at surface mines, and one at the preparation plant for an underground coal mine.

One accident has resulted in a fatality, and three others in serious injuries.

The MSHA district manager and sub-district manager have become increasingly concerned about this situation.

Problem

Recently the local mine operator association asked the MSHA sub-district manager to speak about MSHA procedures for approval of company safety training programs. His presentation took place at the monthly meeting of the group. You were present at the meeting. Following his presentation, members of the audience raised questions about whose responsibility it was to train mine contractors who work on the mine property. The five accident cases summarized on the next page were discussed. A heated discussion followed.

Some operators in the audience stated that contract workers need only hazard training, and that the mining companies have no obligation for any other type of training. A person from another coal company disagreed. He said his company requires their contractors to assume responsibility for having all workers who come on mine property be fully trained in both the initial new miner and annual refresher training, and that his company provides only mine-specific hazard training to these contract workers. He also says most of his company contractors meet this condition by sending their employees to local community college miner training programs. Another operator says that his company trains all their contract workers along with their own miners in regularly scheduled annual refresher training classes.

The arguments become more heated. One operator says it's silly to require the man who fills the soft drink machines to be fully trained, and all that is needed is hazard training. Another person says that companies who let contract workers travel and work unsupervised on mine property are asking for trouble. Another operator shouts, "Maybe your company has time to baby sit the guy who services the porta-toilets! We don't! We have production to worry about!"

Another operator says any company that assumes responsibility for Part 48 initial and annual refresher training for contract workers is assuming an unnecessary liability and asking for trouble.

After 30 minutes of debate, a member of the operator group turns to your supervisor and says, "What do you say about this? Can you clarify this issue?" Your supervisor briefly summarizes his views on the topic. Then he agrees to come to next month's meeting and speak on this topic.

The next day, your supervisor schedules a meeting with you. He assigns you the task of clarifying these issues. He asks you to think about the three questions (#21, 22 & 23) listed on page 47. He then directs you to prepare well-thought-out written answers to these questions. He wants the ideas and strategies you suggest to be worthy of sharing with persons from other mining companies and agencies at the next operators meeting. He reminds you that the strategies should be practical and easy to use so that company, state, and federal inspectors can better identify, correct, and monitor problems of inadequate training or poor supervision of contract workers on mine property.

Contract Worker Accident Summaries

1. While unloading his truck at a coal preparation plant an independent truck owner-operator climbed into a bin to free a stoppage. The coal collapsed beneath him and he was buried under the load from his truck. He passed through the feeder onto the belt to the preparation plant where he was rescued, given first aid, and transported to a local hospital by EMS personnel. The truck drive received only bruises and strains and lost 4 days work. At the time of the accident he was under the supervision of the company weigh-master who warned the truck driver not to climb into the bin. Company records show that 8 months earlier the driver had received hazard training for this area of the mine property that he traveled to many times each day.

2. A worker from a company that repairs broken windows in vehicles was called to a surface coal mine to replace the windshield in an 18 cubic yard pit shovel. The worker drove his service vehicle to the pit, accompanied by a mine foreman. At the edge of the pit the foreman noticed a problem with a drill on the highwall. The foreman got out of the service truck to work with the drill crew. Then the foreman pointed out the shovel and directed the glass repairman to continue into the pit and begin the repairs. The repairman drove into the pit. He pulled his truck up to within 12 feet of the highwall, between the shovel and the wall. As the repairman worked around his truck a fall of rock from the highwall struck and severely damaged his service truck, and struck the repairman breaking his lower left leg. A mine maintenance worker was present throughout the entire period. Subsequent investigation determined: 1) that the glass repairman had received hazard training at this mine seven months earlier; 2) that he pulled up close to the highwall to place his truck in the shade so that he could work in a cooler place; 3) that he did not recognize the hazard from the highwall; and 4) that he received no warning of the potential hazard from any mine company employee. The repairman required hospitalization and lost two months work.

3. A field engineer from an equipment manufacturing company was called to a surface coal mine to check on a leaking seal on a new hydraulic shovel used to strip soil ahead of an advancing pit. Upon entering the mine property the engineer traveled to the shovel by himself in his company utility truck. He made a wrong turn and drove into an area on the highwall side of the pit where a shot was about to be fired. When the shot was fired, the utility truck was upended and overturned. The engineer received a concussion, cuts, and bruises. He required hospitalization and lost 10 days work. Review of company records showed that he had visited this shovel at this mine on two earlier occasions in the last month. He had received hazard training on the first visit.

4. After working on a power line beside a secondary public highway, a electric utility company lineman walked from his utility truck toward a surface coal mine pit 600 yards from the highway. Miners working in the pit saw the lineman standing on unstable soil and rock at the edge of the pit. Suddenly the unconsolidated material collapsed under and around the lineman who was buried as the material slide into the pit. The lineman's body was recovered 45 minutes later. Subsequent

investigation showed that the lineman had no official business on the mine property, that he had never worked on this or other mine property, and that he had never received hazard training specific to working around surface mines.

5. A porta-toilet contract worker was servicing toilets at a surface coal mine. On his way to a maintenance area at the mine, the service worker stopped his truck on a mine road in order to pick up and load a piece of 4" x 4" x 8' angle iron he saw at the side of the road. While attempting to lift the angle iron into his truck, the worker injured his back and fell to the ground. He was unable to move to his truck to radio for help. In about 20 minutes he was found by mine employees who alerted company and local EMS personnel. Subsequent investigation determined that this worker routinely visited and traveled on the mine property to conduct his work, that he was rarely accompanied by mine personnel, and that he had received hazard training once each year for the last three years, his last training having occurred six weeks earlier. The worker required hospitalization, surgery, and 6 months recuperation.

Stop !

Activity K, Exercise Conclusion and Homework Assignment (30 minutes)

Now that you have completed this exercise you can apply some of these principles as you plan, approve, and evaluate education and training programs designed to lowering injury rates and improve miner performance. Here are the steps for your assignment.

1. Select an actual training program or some other activity that you are to plan and/or evaluate as part of your education, training, and safety specialist work.

2. Gather information about the proposed program and the problem it is supposed to solve. Prepare a case study summary* that describes the initial problem. Your summary should look something like the ones listed on pages 7-9 and 49-52 in this exercise problem booklet.

3. Gather and summarize any additional information that may help define the problem. Attach this information to your initial case study summary.

4. Assume that you have adequate time, resources, and authority to investigate and develop plans to correct this problem. Prepare a written description that list the actions you would take (or others took) in an attempt to solve the problem.* The format of your plan should look something like Cody Buchannon's or Harold Klinghorn's proposed program descriptions found on pages 16 and 19 of this problem booklet.

5. Next list the strengths and weakness of the proposed actions or program.* Follow a format something like the one on pages 23-24 in this exercise problem booklet.

6. Next, review the section titled "Basics of Evaluation and Problem Solving" and how these ideas and the IDEAL problem solving process are useful for identifying and defining problems so that effective corrective or preventive programs may be designed and evaluated. (See pages 27-34 in this exercise booklet.)

7. Next, review the "Guidelines for Evaluating Proposed Training Plans and Programs" on page 37 of this problem booklet. Answer the relevant guideline questions for the training program that you are describing and evaluating. Briefly list your answers to these questions.*

8. Review the "Four Methods for Assessing Training Effectiveness" section on pages 40-45 of the problem booklet. Then prepare specific suggestions concerning how the program you have just reviewed might make good use of one or more of the four common methods of training assessment strategies.*

9. Organize all the materials you have developed in response to the previous items in this list. Assemble these materials into a well organized and concise written report provides practical recommendations for the agency whose training program you are designing and/or evaluating.* Write your recommendations so that they are useful, practical, and can lead to the effective implementation and evaluation of the

proposed program's effectiveness. The format of your report should be similar to the reports you and your classmates prepared for Activity J on page 53.

10. Come to the next class prepared to present and discuss your report with your classmates and the instructor. During your presentation, it will be helpful to have written copies (handouts) or overhead projector transparencies of key items in your report. These items are underlined and marked with an asterisk (*) in the above list.

Appendix C: Answer Sheet

Duplicate this copy of the answer sheet for use in your classes. **Booklets should be printed on only one side of the paper.** Each person in your class should have an answer sheet while they are working the exercise.

Answer Sheet for Injury Rate Problem at Maxmore Mine

Work through the exercise using the problem booklet. Don't write in the problem booklet. Write the answer to each question in the appropriate space on this answer sheet. If you need more room, write on the back of the page. The spaces on the answer sheet are numbered to match the questions in the problem booklet. Only a few words are required for each answer. The time allowed for completion of each set of questions is given in parentheses at the beginning of that section. When your time is up, move on to the next set of questions.

Activity A, Reducing Injury Rates at Maxmore, Question 1 (30 minutes)

1. What would you do to reduce this increase in NFDL injuries? (Describe what you would do, why you would do it, and how you would go about it.)

Activity B, Case Study 1 Analysis, Questions 2 & 3 (20 minutes)

2. What suggestions would you offer Truman Wells concerning his approach to the problem? Why?

3. Would you approve his proposed training? Why or why not?

Activity C, Case Study 2 Analysis, Questions 4 & 5 (20 minutes)

4. What suggestions would you offer to Cody Buchannon concerning his approach to the problem? Why?

5. Would you approve his proposed training? Why or why not?

Activity D, Case Study 3 Analysis, Questions 6 & 7 (20 minutes)

6. What suggestions would you offer to Harold Klinghorn concerning his approach to the problem? Why?

7. Would you approve his proposed training? Why or why not?

Activity E, Merits, Questions 8 & 9 (30 minutes)

8. What are the strengths and weaknesses of each training director's approach? Why?

9. Which approach do you feel is the most typical? Why?

<u>Activity F</u>, Problem Identification and Definition, Questions 10 & 11 (30 minutes)

10. In what ways did the identification and definition of the problem influence each training director's choice of strategy?

11. List of some key questions you should ask while gathering information about a proposed training program.

Activity G, Judging Plans, Questions 12 & 13 (30 minutes)

12. Which training director's evaluation plan can provide data useful for judging the worth of the program for decreasing NFDL injuries at this mine? Explain.

13. After Harold Klinghorn's accident repeater program is implemented, the NFDL injury incident rate at the mine drops from 0.17 to 0.04. Harold says this is proof that the program reduces injuries. Is he correct, or is there an alternative explanation? Explain.

Activity H, Using the Guidelines, Questions 14, 15, 16 & 17 (30 minutes)

14. Think about the guidelines in the previous section. Now think about the three case studies. Could seeking answers to these types of questions help you evaluate training plans or programs like these? Explain.

15. Could raising these types of questions help mine trainers improve their instruction? Explain.

16. Education, training, and safety specialists are busy people with many demands upon their time. The guidelines require gathering much information. Are the guidelines of value in the real world, or are they too idealistic and impractical? Explain.

17. List two or three things that you have learned from this exercise that may be useful in your work as you evaluate training plans and programs. Explain how each point listed may help you.

Activity I, Recognizing the Four Methods, Tasks 18, 19 and 20 (40 minutes)

Follow the instructions on page 46 of your problem booklet.

Activity J, Reducing Contract Worker Injuries, Questions 21, 22 and 23 (150 minutes including time to present your answers to the class)

Activity K, Conclusion and Homework Assignment, (30 minutes)

Quiz

Answer each of the following questions by circling the T for true and the F for false. Write short answers for questions 11 and 12.

T or F 1. Truman Wells used a learning evaluation approach to assess the effectiveness of his "proper lifting techniques" program. (See pages 10 and 34.)

T or F 2. It would have been easy and logical for Truman Wells to use a performance (behavior) evaluation for his "lifting techniques" program.

T or F 3. Cody Buchannon used a results (outcome) evaluation to assess his attempts to lower NFDL injuries. (See pages 14 and 34.)

T or F 4. When a trainer uses a results (outcome) evaluation to assess the effectiveness of his or her program, the program is probably well designed.

T or F 5. This quiz is an example of a performance evaluation.

T or F 6. Reaction evaluations provide little valuable information.

T or F 7. Harold Klinghorn used a results (outcome) method of assessing the effectiveness of his accident repeater program. (See pages 18 and 35.)

T or F 8. Harold might have learned something valuable if he had used a reaction evaluation approach for his accident repeater program.

T or F 9. Your answers to the questions in this total exercise are an example of results (outcome) evaluation.

10. Which type of the four types of evaluation do you most often use to assess the effectiveness of your own instruction? Why?

11. Which of the four types of evaluation is used by most of the trainers whose programs you observe?

Appendix D: Summary of Accident Proneness Research

Summary of Accident Proneness Research

For many years accident proneness and malingering were seen as causes for many accidents that occurred in mines and factories. However, well designed studies over the past 20 years have discredited these earlier conceptualizations of accident proneness and malingering as causes of accidents. The methodology and conclusions of many of these earlier studies have also been discredited. The information summarized below is abstracted from the final report of a recent Bureau of Mines funded project.[1]

1. Many well designed studies of safe and unsafe mines and other industrial work places have found relationships between worker personality characteristics and demographic characteristics to be unrelated to accident and injury rates.

2. Proneness and related concepts appear to be more closely related to the physical aspects of the work place and the social and organizational climate than to personality variables. Earlier concepts of proneness as caused by self-destructive personality characteristics, fatalism, and lack of self control have been replaced by concepts of increased risk of accidents because of physical, psychological, and occupational stress, the improper design of work tasks and stations, the greater exposure of some workers to risk than other workers, and the failure to teach workers to comply with correct work practices.

3. Many older studies and more recent studies have shown that accident frequencies for supposedly "accident prone" workers do not generally exceed the predicted chance distribution of accidents across persons in the work force. The exception includes cases where stress affects work performance. Examples include workers stressed by chronic drug and alcohol abuse, bouts of severe mental and physical health problems, and inadequate training, experience and skill for assigned tasks. It is obvious that such stressors increase the likelihood of poor task performance and increase risk of accidents.

4. The often stated aphorism "a few men cause the most accidents" is <u>not</u> evidence for accident proneness. In any chance distribution of events there will always be outliers, e.g. those workers having many accidents and those having none.

5. About the only demographic characteristic that is sometimes reported to be related to injury rate is the age of the miner. However, in most studies the effects of age upon injury rate is confounded with experience, the attrition of severely and fatally injured young miners from the remaining worker population, the increased susceptibility of older miners to certain types of musculoskeletal injuries, and the increased capability of older, more experienced miners to pace themselves and to reject high risk tasks and jobs. These and other confounding factors make the relationship between age and injury rate unclear.

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[1] Cole, H. P., Berger, P. K., Garrity, T. F., Auvenshine, C. D., Szwilski, A. B. Hernandez, M., Blythe, D. K., & Lacefield, W. E. (1985). <u>Generalizations of Medical and Health Compliance Research to Coal Mine Safety</u>. Pittsburgh, PA: U. S. Bureau of Mines, Coal Mine Health and Safety Program.